

The vegetation of Berlengas' island: an attempt to promote the recovery of *Armeria berlenguensis* (Plumbaginaceae)



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1 Introduction

The Berlengas archipelago is in the Atlantic Ocean, on the Portuguese continental shelf, on the western side of Iberian Peninsula, close to Cape Carvoeiro (Peniche). It distances approximately 5.7 miles from mainland.

Berlengas was firstly classified as Natural Reserve in 1981. In 1998 this area was reclassified as Marine Reserve Area increasing its territory to its present size (104 ha) (Amado et al., 2007). In 2011, the International Coordinating Council of UNESCO's Man and the Biosphere Programme (MAB) included the Berlengas archipelago in the World Network of Biosphere Reserves (WNBR), demonstrating the importance of this natural reserve worldwide, proving the importance of this archipelago as a repository of genetic diversity, of species and habitats on the most western area of continental Europe.

Therefore, the Berlengas archipelago hosts important features, due to its insular nature, its geological characteristics, its geographical location and climate, the presence of the Nazaré Canyon, a submarine canyon, along with a low human interference motivated by the small size of the islands and land scarcity. Altogether, these characteristics contributed to promote local high biodiversity, either endemic terrestrial plant species, marine bird species, marine invertebrates, fish or marine mammals (Amado et al., 2007; Queiroga, et al. 2008).

As a result of insular isolation, as well as to severe climatic and edaphic conditions, Berlengas terrestrial flora evolved rapidly and quite differently from the species of mainland. In fact, these plants struggle to survive with extreme dryness, little soil, strong winds and salt. Most of the plants are thicker and smaller in size, with hairy reduced leaves, avoiding being destroyed by wind and excess evaporation. These harsh conditions lead to speciation process that differentiated three endemic species, of great conservation value: *Armeria berlenguensis*, *Herniaria lusitanica* subsp. *berlengiana* and *Pulicaria microcephala*. Two of these species – *A. berlenguensis* and *H. lusitanica* subsp. *berlengiana* – are registered in Annex II of the Habitats Directive, due to their conservation relevance, and are considered critically endangered and endangered, respectively, according to IUCN (Draper, et al. 2003; IUCN, 2017a, 2017b).

Other species of the shore can be found here, some of them having a restricted geographical distribution, either Iberian or Iberian and north Africa: *Angelica pachycharpa*, *Calendula suffruticosa* subsp. *algarbiensis*, *Echium rosulatum*, *Linaria amethystea* subsp. *multipunctata*, *Narcissus bulbocodium* subsp. *obesus*, *Silene latifolia* subsp. *mariziana*, *Silene scabriflora* and *Scrophularia sublyrata* (Queiroga, et al., 2008).

Although, the endemic and halophyte flora of Berlenga is still flourishing, it is being threatened by several factors. To begin with, the introduction, in late 1950s, of the species, an invasive species that until recently was spreading out over the cliffs and hillsides of these islands. Another threat is the oversized population of seagulls that nest on the larger specimens of *Armeria berlenguensis*, destroying them. Finally, the increasing number of ruderal plant species that live on the litter produced by the seabirds, tend to modify natural floristic composition (Tauléigne Gomes, Draper, & Rosselló-Graell, 2001).

Therefore, the control of seagulls has been undertaken for more than ten years and in 2014 a project for the recovery of the Berlengas ecosystems has begun – LIFE BERLENGAS, including the removal of *Carpobrotus edulis*.

Since may 2015, we installed several areas with metal pillars and fishing line, preventing the access of seagulls and other birds. The vegetation of these "exclusion areas" and other equivalent free areas have been monitored seasonally to access the evolution of the vegetation in the past three years, namely the number of *Armeria berlenguensis*, the height of the specimens present and the number of species.

2 Methods

Installation of 10m x 10m **study areas** A1-A6 (with *Armeria berlenguensis* present) and B1-B6 (without the species present) in may 2015

A1-A3 and B1-B3 are "**exclusion zones**", with **structures** built from pillars and fishing line, preventing the access of birds and other animals to study areas.

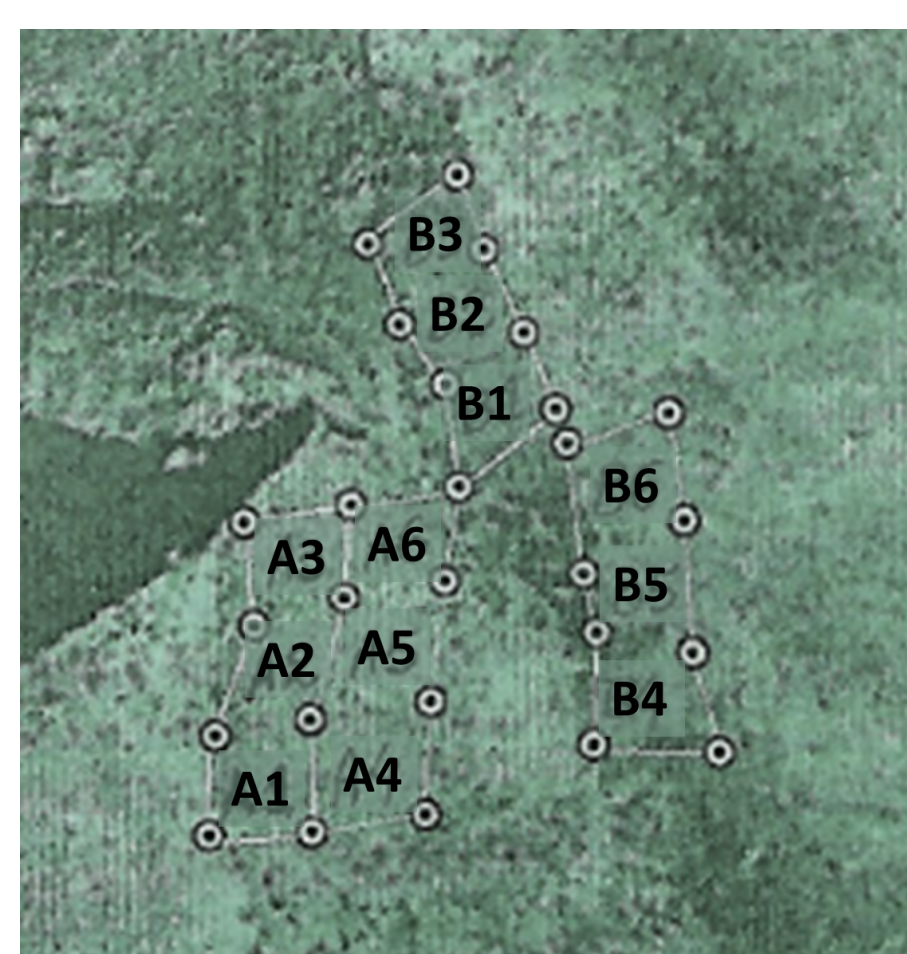


Figure 1. Survey areas



Figure 2. Exclusion zone with *A. berlenguensis*



Figure 3. *A. berlenguensis*



Figure 4. seagull nest on a large specimen of *A. berlenguensis*

Surveys were performed every three months, from may 2015 to may 2018:

- ↳ Total percentage of coverage
- ↳ Number of *A. berlenguensis*
- ↳ *A. berlenguensis* height
- ↳ Species present
- ↳ Percentage of each species

Statistical analysis

A principal component analysis (PCA) for the percentage of occurrence of the observed species was performed between:

- ↳ Study areas
- ↳ Sampling periods

3 Results

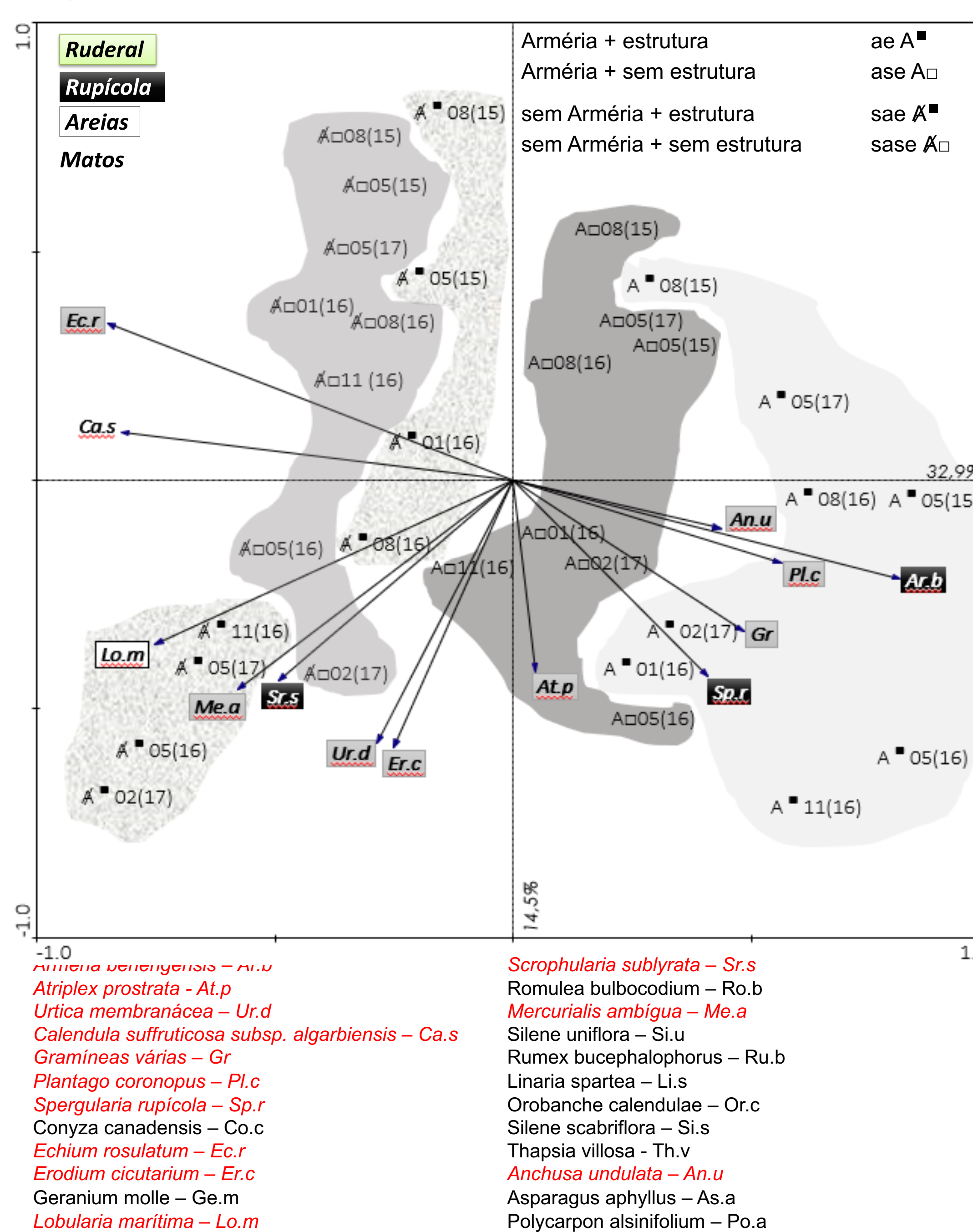


Fig.5. PCA

The PCA showed that 47.3% of total variance was explained by the two principal components. PC1 expressed 32.9% of total variance, which is the most significant response regarding the separation between structure treatments. This demonstrates that the percentage of *A. berlenguensis* (especially), *Anchusa undulata*, and *Plantago coronopus* increases with the presence of the structures, for all years, mainly in May (followed by August). These results reinforce, thus, that the absence of disturbance seems to favour the growth of the rupicola *A. berlenguensis* but also of some ruderal species. Moreover, *Echium rosulatum* and *Calendula suffruticosa* subsp. *algarbiensis* presented higher cover percentages without *A. berlenguensis* (with and without structures), as they are ruderal species tending to rapidly occupy available nitrophilous soil. On the other hand, *Lobularia maritima*, *Mercurialis ambigua*, *Scrophularia sublyrata*, *Urtica membranacea* and *Erodium cicutarium* increased in *A. berlenguensis* areas without structure, for all analyzed years, mostly in autumn and winter samples. In general, those species presented a null correlation with *A. berlenguensis*, *Anchusa undulata*, *Plantago coronopus*, *Echium rosulatum* and *Calendula suffruticosa* subsp. *algarbiensis*.

5 References

- Amado, A., Gafeira, C., Teixeira, A., Preto, A., Bártolo, P., Fonseca, H., & Moris, L. (2007). Plano de Ordenamento da Reserva Natural Das Berlengas. Instituto Da Conservação Da Natureza E Da Biodiversidade, 1–253. Retrieved from http://www.cm-peniche.pt/uploads/PDF_Berlengas_Laboratorio/PO_RNB_Relatorio.pdf
- Caldas, F. B. (2011a). *Armeria berlenguensis*. The IUCN Red List of Threatened Species 2011: e.T162004A5527623. <http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T162004A5527623.en>. Retrieved April 9, 2018, from <http://www.iucnredlist.org/details/162004/0>
- Caldas, F. B. (2011b). *Herniaria lusitanica* ssp. *berlengiana*. The IUCN Red List of Threatened Species 2011: e.T162449A5592185. Downloaded on 13 April 2018. Retrieved April 9, 2018, from <http://www.iucnredlist.org/details/162449/1>
- Legendre, L., Legendre, P. (1979). *Ecologie numerique. 1. Le traitement multiple des donnees ecologiques. et les Presses de l'Universite du Quebec, Masson, Paris, p. 197.*
- Queiroga, H., Leão, F.; Coutinho, M. (2008). "Candidatura das Berlengas a Reserva da Biosfera da UNESCO." Instituto Do Ambiente E Desenvolvimento, 38–83.
- Tauléigne Gomes, C., Draper, D., & Rosselló-Graell, A. (2001). *Données sur la végétation halophile; l'archipel des Berlengas (Estremadura, Portugal)*. Bocccone, 13, 537–542.
- ter Braak, C.J.F. & Smlauer, P. (2002). *Canoco Reference Manual and Canodraw forWindows User's Guide: Software for Canonical Community Ordination (Version 4.5)*, Microcomputer Power, Ithaca.
- Zar, J.H. (2010). *Biostatistical Analysis (5th edition)*, Prentice Hall, p. 944.

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4 Conclusion

Overall, there seems to be a recovery of the vegetation of the island, either rupicola or ruderal species. Besides PCA, data indicate a slight correlation between the presence of the protection structure and the number of *A. berlenguensis* specimens. Still, these results need to be extended in time, so that this trend can be confirmed.